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DRAFT
Environmental Effects Analysis Report
Weather Deck Runoff

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DRAFT

ENVIRONMENTAL EFFECTS ANALYSIS REPORT

DECK RUNOFF

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List of Acronyms

ALRE	Aircraft Launch and Recovery Equipment
BCC	Bioaccumulative Contaminant of Concern
BOD	Biochemical Oxygen Demand
COC	Constituent of Concern
COMDTINST	Commandant Instruction
DFM	Diesel Fuel Marine
DO	Dissolved Oxygen
EEA	Environmental Effects Analysis
EEAR	Environmental Effects Analysis Report
EOMZ	Edge of Mixing Zone (35 m from EOP)
EOP	End of Pipe
EPA	Environmental Protection Agency
ETS	Exterior Topside Surface
FAS	Fueling-at-Sea
HIFR	Helicopter In-Flight Refueling
MOGAS	Motor Gasoline
MPCD	Marine Pollution Control Device
MSDS	Material Safety Data Sheet
NSN	National Stock Number
NSTM	Naval Ship’s Technical Manual
NTU	Nephelometric Turbidity Units
OPNAVINST	Operational Naval Instructions
PAH	Polynuclear Aromatic Hydrocarbon
RAST	Recovery, Assist, Securing and Traversing
TDS	Total Dissolved Solids
TMP	Topside Management Plan
TSS	Total Suspended Solids
WQC	Water Quality Criteria

Environmental Effects Analysis Report for Preservation of Exterior Topside Surfaces Component of Deck Runoff Discharge

1.0 Introduction

This document presents the results of the environmental effects analysis (EEA) for the deck runoff discharge. Deck runoff is one of 25 discharges incidental to the normal operation of vessels of the Armed Forces that requires the use of a marine pollution control device (MPCD) (EPA and DOD, 1999). Deck runoff consists of precipitation, washdowns, and seawater (green water) that falls on the weather deck of a vessel and is discharged overboard through deck openings (40 CFR 1700.4). A vessel intermittently produces deck runoff when water falls on or is applied to the exposed surfaces, such as weather and flight decks, superstructure, bulkheads, and the hull above the waterline of a vessel (e.g., freeboard and bulwark).

Precipitation and green water are the primary sources of the liquid discharge, both of which are influenced by the weather, area of operation, and mission characteristics of a particular vessel. Additionally, multiple topside processes contribute constituents to deck runoff discharges. Some of these processes occur across most vessel classes (e.g., preservation of exterior topside surfaces), while other processes are limited to a few vessel classes (e.g., launching of fixed wing aircraft by aircraft carriers). The combination of source water and the diverse topside processes that contribute to the deck runoff discharge results in a high degree of variability within and among vessel classes.

The Discharge Assessment Team (DAT) concluded that deck runoff, due to its variable nature, is best controlled by managing the processes that contribute constituents to the discharge. The management steps envisioned to prevent or mitigate environmental impacts would be applicable to any vessel on which the process is employed. Therefore, vessel groups for the deck runoff discharge were not created as described in the *Development of Vessel Groups and Selection of Representative Vessels for Feasibility and Environmental Effects Analyses* guidance (EPA and DOD, 2000a). Instead, the DAT organized the topside processes that contribute constituents to deck runoff into six main categories: (1) aircraft launch and recovery equipment; (2) buoy maintenance; (3) cleaning activities/general housekeeping; (4) deck machinery and weapons lubrication; (5) exterior topside surfaces preservation; and (6) vessels, aircraft, and vehicles refueling and lubrication. Additionally, the DAT determined that a Topside Management Plan (TMP) is the only MPCD option that passes the screening process described in the *Marine Pollution Control Device Screen Guidance Document* (EPA and DOD, 2000b).

For each deck runoff process category, the DAT developed TMP objectives to describe the desired outcome of controlling each category of the topside processes that contribute to deck runoff. The TMP identifies examples of activities or devices that could be implemented to achieve the desired objectives. However, alternative activities may be implemented, provided they are either better or equally effective at controlling the discharge as the practices or devices they are replacing, and are included in the next revision of the TMP. Further details about the TMP can be found in the Deck Runoff's *Feasibility Impact Analysis Report* and *Topside Management Plan MPCD Option Group Screen*.

1.1 Application of the Environmental Effects Analysis Process

This EEA report (EEAR) evaluates the deck runoff discharge associated with the six process categories, and with the implementation of the TMP objectives. The available information bounded the scope of the environmental effects analysis. The absence of analytical sample data prevents the comparison of constituent concentrations to numerical water quality criteria and the calculation of constituents' hazard quotient, mass loading, and toxic pound equivalents. This EEAR is limited to qualitative comparisons to narrative water quality criteria, and assessments of non-indigenous species (NIS) and bioaccumulative contaminants of concern (BCC) as they relate to the six categories of topside processes. EEA methodology is discussed further in the *Environmental Effects Analyses Guidance* (EPA and DOD, 2000b).

2.0 Description of Deck Runoff Process Categories

The characterization of deck runoff discharge was based on information collected by the UNDS deck runoff shipboard survey team, process knowledge, and technical publications. Sections 2.1 to 2.6 summarize the main characteristics of the six process categories that contribute constituents to the deck runoff discharge. For further details on discharge characterization information and data sources, the reader should refer to the deck runoff *Characterization Analysis Report* (EPA and DOD, 2002).

2.1 Aircraft Launch And Recovery Equipment Topside Operations

Armed Forces vessels with fixed wing aircraft launch and recovery equipment (ALRE) are limited to 14 aircraft carriers distributed among four Navy vessel classes (CVN 65, CVN 68 CV 63, and CV 67 Classes).[1] The three systems used during ALRE operations are arresting gear, catapult launchers, and jet blast deflectors. Catapult launchers and jet blast deflectors help launch fixed wing aircraft, while the arresting gear assists with the recovery of fixed wing aircraft. The size of aircraft carriers and the height of their flight decks above the sea surface reduce the probability of green water washing over the weather decks. Therefore, precipitation is the main source of deck runoff liquid discharge from ALRE operations. The contribution of deck runoff constituents by these three systems is described in Sections 2.1.1, 2.1.2, and 2.1.3. Section 2.1.4 provides the TMP performance objectives, and examples of activities that can control the discharge of constituents from ALRE operations.

2.1.1 Arresting Gears

The arresting gear system is designed to rapidly decelerate fixed wing aircraft during landing. The main features of the system are a set of four cables across the flight deck and an emergency barricade recovery nylon webbing assembly. The arresting gear system requires arresting gear grease (MIL-PRF-81322F), Grikote 31EP lubricating oil (no military specification), dry cleaning solvent (MIL-PRF-680 Type III), and anti-seize compound (A-A-59313) for normal operation.

2.1.2 Catapult Operations

[1] Amphibious assault ships (LHD 1 and LHA 1 Classes) carry AV-8B Harrier aircraft. These fixed wing aircraft are vertical and short take-off and landing (V/STOL) capable and do not require ALRE.

Catapults are steam-driven mechanisms that contribute constituents to deck runoff discharge through leaks from the catapult sealing strips to the catapult troughs. Each aircraft carrier is equipped with four catapults. The catapults are either Mod 1 or Mod 2 design. Mod 2 catapults are a new design installed in the five newest aircraft carriers (CVN 72 to CVN 76). These new catapults require lower steam pressure and less maintenance, but use approximately 0.83 gal of oil per launch, twice as much as the older Mod 1 design (EPA and DOD, 1999). Approximately half of the oil used per launch is discharged overboard through the post-launch retraction exhaust discharge, and some accumulates in the catapult water break tank.[2] An undetermined amount of oil leaks into the catapult troughs, some of which is carried overboard with deck runoff entering the catapult's slotted openings. Deck runoff flows through the catapult troughs to a pipe where it is discharged overboard. Strainer baskets fitted into the troughs collect debris from the runoff before it is discharged.

Fixed wing aircraft are not launched inside 12 nm, however, carriers conduct no-load catapult test launches before any deployment and after major overhaul and repairs. Constituents in the catapult troughs can originate from 120 grade lubricating oil (SAE J1899), dry cleaning solvent (MIL-PRF-680 Type III), and high temperature grease (DOD-G-85733). The 120 grade lubricating oil and produces a sludge residue on the catapult trough. The sludge residue can be entrained in deck runoff during heavy precipitation and produce sheen and release floating materials in the receiving waters (Opet, 2000).

2.1.3 Jet Blast Deflectors

Jet blast deflectors are sections of an aircraft carrier deck that are raised prior to an aircraft launch to deflect the high velocity exhaust and heat from aircraft jet engines. After heavy rainfall, constituents from jet blast deflectors can contribute to deck runoff. The sources of deck runoff constituents from jet blast deflectors include lubricating oil (NSN 9150-01-432-0511), a general purpose grease (MIL-G-23549; NSN 9150-00-823-8047), anti-seize compound (A-A-59313; NSN 8030-00-292-1102); and accumulated jet exhaust soot, which may contain carbonaceous materials, sulfates, and by-products of incomplete combustion of JP-5 fuel (MIL-DTL-5624T).

2.1.4 Performance Objective: Aircraft Launch and Recovery Equipment

The performance objective for aircraft launch and recovery equipment is for the vessel's responsible party to prevent the discharge of oils, greases, solvents, soot, and other materials associated with ALRE that may negatively impact water quality. Examples of activities that could be performed to meet the performance objective of aircraft launch and recovery equipment include:

- Minimizing catapult test launches in port;
- Cleaning and stowing ALRE before transiting within 12 nm; and
- Using environmentally compliant lubricants for catapults or other equipment associated with ALRE.

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[2] The catapult water break tank and post launch retraction exhaust discharge is addressed as a separate UNDS discharge (EPA and DoD, 1999).

- Installing an oil trap or small gravity separator in the catapult drain trough overboard discharge line that is capable of collecting un-emulsified oil before it is discharged overboard.

Although other activities could be included in a vessel's TMP, this report discusses only the activities listed above. Individual commands or vessel's custodians are encouraged to explore other activities and develop innovative methods, products, or devices to meet the plan's objectives (e.g., using environmentally preferable cleaners, greases, and lubricants provided the product meets the military specification requirements of the equipment)., this report discusses only the activities listed above.

2.2 Buoy Maintenance

The U.S. Coast Guard (USCG) is the only branch of the Armed Forces that retrieves, maintains, and resets navigational buoys. The majority of navigational buoys are located in inland and coastal waters inside 12 nm. Vessels that perform this task range from the 49 ft Boat Utility Stern Loading (BUSL 49) to the 225 ft Seagoing Buoy Tender (WLB 225) (Table 1).

The UNDS shipboard survey team documented buoy maintenance operations aboard a WLM 175 Class vessel. This vessel class is the third longest (175 ft), has the second largest number of vessels in service (14), and is one of the three newest buoy tender classes. The other classes of seagoing and coastal buoy tenders in service (i.e., WLB 225, WLM 180, and WLM 133) are similar in size, provide maintenance to the same type of buoys, have similar operational profiles, and therefore have similar discharge characteristics to the WLM 175. These vessel classes maintain the largest buoys, and are expected to generate the largest amount of constituents for this component of deck runoff.

Table 1. List of U.S. Coast Guard Vessel Classes that Service Navigational Buoys.

Vessel Class	Vessel Type	Length (ft)	Number of Vessels
WLB 225	Seagoing Buoy Tender	225	5*
WLB 180	Seagoing Buoy Tender	180	13**
WLM 175	Coastal Buoy Tender	175	14
WLM 133	Coastal Buoy Tender	133	1
WLR 75	River Buoy Tender	75	12
WLR 65	River Buoy Tender	65	6
WLI 100	Buoy Tender Inland	100	2
WLI 65	Buoy Tender Inland	65	4
BUSL 49	Boat Utility Stern Loading	49	26

* 11 more vessels are planned for this class.
** Vessels in the WLB 180 class are being phased out and replaced by WLB 225 and WLM 175.

2.2.1 Maintenance and Preservation of Buoys

Navigational buoys range in design from unpainted plastic buoys to steel ocean buoys. When deployed, navigational buoys are connected to concrete block sinkers by iron chains. Cranes and cross-deck winches haul buoys aboard the tender. Inspection, cleaning, and maintenance commence once the buoys are onboard and secured to the tender's buoy deck.

Paint chips are generated when biofouling material adhered to the buoy surface is removed with metal scrapers and pressure washers, and when painted surfaces are prepared for touch-up painting. No chemical paint removers are used on navigational buoys. Major repainting and maintenance is done at shore facilities, with only touch-up painting conducted onboard while underway.

Onboard scraping, pressure washing, and pre-painting surface preparation generates approximately 4 gal of debris from each serviced buoy, of which less than approximately 1 % are paint chips. Because most of the scraping occurs on the buoy surfaces located below the waterline, it is assumed that most of the paint chips are from primer and antifouling ablative paints.

The non-paint chip component of the debris consists of biofouling material (e.g., epiphytic algae and invertebrates), marine bird and mammal excrements, rust, and sediments (e.g., mud and sand) attached to the buoys, concrete sinkers, and steel chains. The precise composition of this material cannot be ascertained because it is temporally and spatially variable. Some of the debris consists of neutrally buoyant material (e.g., filamentous algae and soft body invertebrates) that can remain suspended in the water column. Other types of debris are heavier (e.g., encrusting algae, barnacles, and sediments) and will sink through the water column.

Additional information on buoy handling activities can be found in "*Identification of Weather Deck Runoff Discharge Constituents Onboard a U.S. Coast Guard WLM Class Coastal Buoy Tender*" (Wenzel, 2000).

2.2.2 Performance Objective: Buoy Maintenance

The performance objective for buoy maintenance is for the vessel's responsible party to prevent the discharge of rust, paint chips, paint drips, cleaning compounds, and other materials associated with buoy maintenance that may negatively impact water quality. An additional objective of buoy maintenance is to prevent the transport of non-indigenous invasive species with fouling material and sediment released during buoy maintenance operations.

Examples of activities that could be performed to meet the performance objective of buoy maintenance include:

- Using high pressure washers;
- Conducting only minor buoy repairs underway; and
- Discharging biofouling material and sediment from where the buoy was pulled.

2.3 Cleaning Activities/General Housekeeping

The type and extent of cleaning and general housekeeping activities, and the preservation of exterior topside surfaces (see Section 2.5), depends largely on the vessel class and area of operation. The sources of water are freshwater and seawater from the vessel's firemain system. For evaluation purposes, cleaning and general housekeeping activities were divided into four major processes: (1) aircraft washdowns; (2) electronic intelligence/navigation systems maintenance; (3) equipment and vehicle washdowns; and (4) exterior topside surface washdowns. These four processes are described in Sections 2.3.1 to 2.3.4.

2.3.1 Aircraft Washdowns

Aircraft washdowns include cleaning the exterior surfaces and engines of fixed wing and rotary wing aircraft. Aircraft washdowns remove dirt, salt, hydraulic fluid (MIL-PRF-83282D), lubricating oil (MIL-PRF-23699F) and greases (MIL-PRF-23827C and MIL-PRF-81322F).

The exterior surfaces of fixed wing aircraft are cleaned with fresh water and aircraft cleaning compound (MIL-C-85570C Type II) outside 12 nm. On aircraft carriers (CV and CVN Class designation), fixed wing aircraft are washed every 14 days, while on amphibious assault ships (LHD 1 and LHA 1 Classes) fixed wing aircraft are washed every seven days. All washdown wastewater is discharged overboard outside 12 nm.

A complete freshwater washdown of Navy rotary wing aircraft is performed every seven days. Navy rotary wing aircraft are washed outside 12 nm. The washdown solution consists of approximately 8 oz of aircraft cleaning compound (MIL-C-85570C Type II) for every 1 gal of freshwater. The aircraft is wetted down and rinsed using an unspecified quantity of freshwater. The washwater and aircraft cleaning compound mixture drains directly overboard. Before and after rotary wing aircraft washdowns, all aircraft fittings are greased to prevent water intrusion.

While underway, USCG rotary wing aircraft are washed every day with freshwater and VCI-415 cleaning compound mixture (USCG, 1999; USCG, 2000b). The vast majority of washdowns occur outside 12 nm. USCG cutters operating within 12 nm are not likely to have an aircraft onboard; if an aircraft were required, it would probably be operating from a shore base.

Fixed wing and rotary wing aircraft engines are cleaned with gas path cleaner (MIL-C-87937D or MIL-C-85704C). Rotary wing aircraft engines and rotors are rinsed with freshwater after each flight. The frequency of engine wash with gas path cleaner depends on the type of aircraft and ship location. Although USCG rotary wing aircraft engines may be washed within 12 nm, the vast majority of those washes occur outside 12 nm because if a cutter is operating within 12 nm, it not likely to have an aircraft embarked. Navy fixed wing aircraft engines are cleaned outside 12 nm. For wastewater from aircraft engine washdowns Appendix L of Operational Naval Instruction (OPNAVINST) 5090.1B explicitly states: "*Overboard discharge permitted beyond 12 nm of shore. Inside 12 nm and in port, collect and containerize for shore disposal*" (Navy, 1999a).

2.3.2 Electronic Intelligence/Navigation Systems Maintenance

Armed Forces vessels have a variety of on-deck electronic systems, consisting of antennas and radar, for intelligence and navigation purposes. Process information on electronic intelligence/navigational systems was obtained during shipboard assessments of various vessel classes (e.g., AOE 6, DDG 51, MCM 1, WLM 175, and WPB 110). The MCM 1 Class vessels clean the surface search and navigation radar rotating assemblies with freshwater and a small amount of a cleaning compound (Simple Green™), which has the potential to contribute to deck runoff both inside and outside 12 nm. Radar equipment on all platforms is self-contained, so maintenance is limited to checking oil and grease levels. Whip antenna maintenance on each platform consists of applying small amounts of silicone to the couplers and applying a sealing compound that hardens in 24 hr; therefore deck runoff contamination does not occur. Preservation is limited to touch up painting. With the exception of the MCM 1 Class, electronic intelligence/navigation systems maintenance does not contribute to deck runoff.

2.3.3 Equipment and Vehicle Washdowns

Several vessel classes may carry and transport vehicles on the weather deck. These vessel classes include, but are not to limited to, landing craft (e.g., LCM 6, LCM 8, and LCU 2000), non-powered barges, Army logistic support vessels (LSV), dock landing ships (LSD 49), and aircraft carriers (CVN and CV). Transported vehicles can be part of the vessel's standard onboard equipment (e.g., aircraft towing tractors) or cargo (e.g., tanks and humvees).

Vehicles are washed with freshwater to prevent accumulation of salt from sea spray. The constituents from equipment and vehicle washdowns that contribute to deck runoff include salt residue, dirt, vehicle oil and grease, and cleaning compounds. Most equipment and vehicle washdowns are performed outside 12 nm, however some residual constituents can remain trapped in the deck surfaces and contribute to deck runoff inside 12 nm.

2.3.4 Exterior Topside Surface Washdowns

Exterior topside surface (ETS) washdowns are performed on all vessel classes. The type, frequency, and magnitude of the washdowns depend upon the vessel class and area of operation. Washdowns can be conducted while pierside or underway, either inside or outside 12 nm. Washdowns range from freshwater rinse with a garden hose and hand scrub with a sponge on small boats to flight deck scrubs with one-person rider-type scrubber carts on aircraft carriers. Expected constituents in washdown wastewaters include dirt, soot, salt residues and corrosion deposits, oil and grease, traces of fuel and hydraulic fluids, aircraft tire residues, paint fragments, soot, and cleaning compounds (e.g., Simple Green™, General Purpose Detergent [MIL-D-16791], and B&B-88 flight deck cleaner). Unknown amounts of water (freshwater or seawater), cleaning compounds, and residue deposited on the deck are discharged overboard during deck washdowns. Although cleaning compounds may vary by vessel class, the deck washdown process is similar for all vessels. Depending on the vessel and its mission, deck washdowns may occur inside or outside 12 nm.

2.3.5 Performance Objective: Cleaning Activities/General Housekeeping

The performance objective for cleaning activities/general housekeeping is for the vessel's responsible party to prevent the discharge of cleaning compounds, hydraulic fluids, oils, fuels, greases, dirt, salts, soot, and other materials associated with cleaning activities/general housekeeping that may negatively impact water quality.

Examples of activities that could be performed to meet the performance objective of cleaning activities/general housekeeping include:

- Minimize cleaning for aircraft, ETSs, equipment, and vehicles within 12 nm;

- Using a vacuum to remove water from aircraft washdowns conducted outside 12 nm;
- Using a flight deck scrubber; and
- Cleaning tie down fixtures with vacuums.

Although other activities could be included in a vessel's TMP [[add similar language to that suggested in Section 2.1.4 above]] (e.g., dividing the weather deck into zones to facilitate cleaning and using environmentally preferable cleaners, greases, and lubricants provided the product meets the military specification requirements of the equipment), this report discusses only the activities listed above.

2.4 Deck Machinery and Weapons Lubrication

Lubrication of deck machinery and weapons generates traces of oil, grease, and hydraulic fluids that can become trapped in the deck surface and contribute to deck runoff through precipitation and green water. Lubrication of deck machinery and weapons is a common practice on most Armed Forces vessels, and therefore, it is expected to be a major source of oil and grease constituents in deck runoff. However, the type and extent of potential constituents discharged depend largely on the vessel class and area of operation. For example, the similar size 225 ft Seagoing Buoy Tender (WLB 225) and the 210 ft Medium Endurance Cutter (WMEC 210) Classes have davits that haul rigid inflatable boats. However, both classes have noticeable differences in the deck machinery and weapons found onboard. The WLB 225 Class has a 20 ton crane with a 60 ft boom to lift navigational buoys, while the WMEC 210 Class lacks similar equipment, but has one 25 mm and two .50-caliber machine guns. Therefore, differences are expected between the two vessel classes in the amount and composition of constituents from deck machinery and weapon lubrication that could contribute to deck runoff.

Oils and greases used by Navy and Military Sealift Command (MSC) vessels are described in the U.S. Navy Naval Ship's Technical Manual (NSTM) Chapter 262 *Lubricating Oils, Greases, Specialty Lubricants, and Lubricating Systems* (Navy, 1999b). The USCG refueling and lubrication practices are described in Commandant Instruction (COMDTINST) M9000.6D, *Naval Engineering Manual* (USCG, 2000a).

For evaluation purposes, deck machinery and weapons lubrication activities were divided into seven major systems: (1) aircraft elevators; (2) buoy handling; (3) mine handling; (4) recovery, assist, securing, and traversing; (5) ship's boats and launching; (6) stores handling; and (7) weapons. These seven processes are discussed in Sections 2.4.1 to 2.4.7.

2.4.1 Aircraft Elevators

Aircraft carriers (CV and CVN Class designation), amphibious assault ships (LPH 1 and LHA 1 Classes), and a mine countermeasure ship (MCS 12, a former amphibious assault ship) have aircraft elevators. The elevators are used to move aircraft from the hangar deck to the flight deck. Elevator cables, rails, and stanchions are lubricated by hand using a general-purpose grease with a synthetic oil-based (DOD-G-24508A), and petroleum based water-resistant greases (MIL-G-23549, MIL-G-24139A and MIL-G-18458B) (Navy, 1999b). These elevator components are exposed to the weather where the rain, wind, and sea spray (greenwater) cause these lubricants to fall to the deck or receiving water, contributing to deck runoff both inside and outside 12 nm.

2.4.2 Buoy Handling Systems

USCG buoy tenders are equipped with buoy handling systems. These vessels provide support and maintenance to navigational buoys (see Section 2.2 and Table 1). Buoy tenders are equipped with cranes and cross-deck winches to haul on deck and deploy navigational buoys. The wire rope on the cranes and cross-deck winches is lubricated with the same grease used to lubricate wire ropes in Navy vessels (MIL-G-18458B). This grease lubricates the wire components and provides a corrosion barrier (Navy, 1999b). Hydraulic fluid (MIL-H-17672D) is used in cranes and cross-deck winches. During buoy maintenance, incidental drips of grease and oil can deposit constituents on the deck. Although the deposited grease and oil is immediately cleaned, some residues can remain trapped in the deck surfaces and contribute to deck runoff both inside and outside 12 nm.

2.4.3 Mine Handling Systems

The coastal mine hunter OSPREY Class (MHC 51) and the mine countermeasure AVENGER Class (MCM 1) are the only two vessel classes with equipment on deck to locate, identify and destroy moored and bottom mines.[3] This equipment includes outrigger booms, cranes, and cable reels that require lubrication with MIL-G-24139A grease and MIL-PRF-2105E oil. This equipment also has the potential of producing hydraulic fluid (MIL-H-17672D) leaks. Because of the relatively low vertical profile of the MCM 1 and MCH 51 Classes, green water can splash over the weather deck and carry grease or hydraulic fluids that may fall on deck overboard, both inside and outside 12 nm.

2.4.4 Recovery, Assist, Securing, and Traversing Systems

Recovery, assist, securing, and traversing (RAST) systems help helicopters land on vessels during rough weather. Many air capable vessel classes use RAST systems (e.g., DD 963, FFG 7, and CG 47). During a RAST landing, a cable connects the helicopter to a winch on the vessel, which helps guide and land the aircraft. The cables and track for the motor require lubrication using MIL-PRF-81322F grease. Although grease deposits are immediately cleaned up, the potential exists for residual amounts of grease to remain on the deck and contribute to deck runoff both inside and outside 12 nm.

2.4.5 Ship's Boats and Launching Systems

All ships carry boats that are used for various support activities. These boats can range from rigid hull inflatable boats (RHIB) of less than 20 ft in length to utility boats (UB) greater than 50 ft in length. These boats are launched using cranes or davits. The cranes or davits lift the boats by attachment to a wire rope that is lubricated using various military standard greases including MIL-G-18458B, and MIL-G-23549 (Navy, 1999b). The cables are also cleaned with MIL-PRF-680 Type III, Simple Green™, and JP-5. Exposure to the weather causes these lubricants and cleaners to fall to the deck and potentially contribute to deck runoff both inside and outside 12 nm. In addition, traces of hydraulic fluid (MIL-PRF-17672D (3)) from the cranes

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[3] The USS INCHON (MCS 12) is a mine countermeasure ship originally designed as an amphibious assault ship. The vessel carries up to 10 helicopters and provides alongside support to MCM and MHC vessels. The MCS 12 does not carry minehunting booms and cranes on deck.

can also contribute constituents to deck runoff. Paint debris from touch-up painting of boats that are trapped in rough ship deck surfaces may also contribute constituents to deck runoff.

In addition to the boat's launching systems, the boat's engines can be a source of deck runoff constituents. The engines of some boats are run periodically on deck to ensure proper operation. This operation deposits a mixture of constituents from the engine's wet exhaust (e.g., by products of incomplete combustions including fuel and engine oil) onto the deck of the vessel, creating the potential to contribute to deck runoff both inside and outside 12 nm.

2.4.6 Stores Handling Systems

Stores handling systems are used to transfer supplies from ship-to-ship (outside of 12 nm) or shore-to-ship. However, these systems have the potential to contribute constituents to deck runoff both inside and outside 12 nm. These systems consist of kingpost assemblies, wire ropes, and cable drums. Vessel classes whose predominant role is to conduct ship-to ship transfers of supplies include, but are not limited to, fast combat support ships (AOE 1 and AOE 6 Classes), ammunition ships (T-AE 26), and underway replenishment oilers (T-AO 187). Greases (MIL-G-23549C, MIL-G-24139A) are the main source of constituents from stores handling systems. Although spills are immediately cleaned up, residual engine oil and hydraulic fluids have the potential to remain on the deck and contribute to deck runoff both inside and outside 12 nm.

2.4.7 Weapons Systems

Fixed weapon systems require cleaning and lubrication. Some weapons systems have protective covers to minimize exposure to the weather. The majority of these covers are not weather-tight, allowing lubricants to be deposited on the weather deck or directly overboard. Oil (MIL-L-63460D) and grease (MIL-G-21164D) are used to lubricate the weapons systems. Cleaners used for weapons systems include MIL-PRF-680 Type III (see Section 2.2.1). Lubricants and cleaners can be entrained in deck runoff inside and outside 12 nm.

2.4.8 Performance Objective: Deck Machinery and Weapons Lubrication

The performance objective for deck machinery and weapons lubrication is for the vessel's responsible party to prevent the discharge of greases, oils, fuels, hydraulic fluids, solvents, cleaning compounds, and other materials associated with deck machinery and weapons lubrication that may negatively impact water quality.

Examples of activities that could be performed to meet the performance objective of deck machinery and weapons lubrication include:

- Using a wire rope lubricator;
- Using covers or protective devices such as;
  - Chafing guards at friction points on exposed hydraulic hoses;
  - Extensions on winch engine oil drains;
  - Fitted covers on cranes and mounts/weapons;
  - Sample fittings on winch engines; and
  - Tarps used during equipment maintenance.

Although other activities could be included in a vessel's TMP (e.g., using nylon rope on light duty cranes, modifying practice of daily outboard checks, and using environmentally preferable cleaners, greases, and lubricants provided the product meets the military specification requirements of the equipment), this report analyzes only the activities listed above.

2.5 Exterior Topside Surface Preservation

All vessels are subject to some type of preservation of exterior topside surface (ETS) activities while afloat, with the exception of boats that are hauled out of the water after their daily use. The type and extent of preservation activities depends largely on vessel class and area of operation. For example, due to differences in equipment and materials on deck, preservation requirements are significantly different between the 72 ft LCM 8 mechanized landing craft, a vessel used to transport tracked or wheeled vehicles and troops, and the similarly-sized USCG 87 ft WPB, a vessel used for coastal patrol duties. Similarly, a DDG 51 guided missile destroyer with periodic deployments to hot and dry climates (e.g., Persian Gulf) has different requirements for preservation of exterior topside surfaces than a DDG 51 vessel assigned to a cold, humid climate (e.g., North Atlantic).

Current practices for the preservation of Navy and MSC vessels are described in NSTM Chapter 631 Volumes 1 to 3 *Preservation of Ships* (Navy, 1996b), Chapter 634 *Deck Covering* (Navy, 1991), and Chapter 583 *Boats and Craft* (Navy, 1998). The USCG painting and preservation practices are described in COMDTINST M10360 (series), *Coatings and Color Manual* (USCG, 2001), while the Army guidelines for preservation and painting of in-service watercraft are described in the Department of the Army 1990 Technical Bulletin TB 43-0144 (U.S. Army, 1990).

2.5.1 Restoration of Painted Surfaces

Rain precipitation and green water are the primary sources of liquid discharge from the painting and preservation of exterior topside surfaces. The dominant discharge constituents expected from the preservation of vessel exterior surfaces are paint chips and associated debris (e.g., non-skid material fragments and rust). Paint chips consist of fragments from topcoat, anticorrosive, and primer paints. Paint chips and associated debris are generated when rust and loose paint are removed with needle guns, and other paint removal equipment. Paint chip releases can also occur as result of weathering processes that affect vessel superstructure surfaces. The USCG COMDTINST M10360.A and Appendix L of OPNAVINST 5090 specify that paint wastes, including chips and debris, must be containerized for shore disposal. However, it is expected that some of the fine-grain particles produced during surface preparation remain in deck crevices, and may eventually contribute to deck runoff discharge.

2.5.2 Performance Objective: Exterior Topside Surfaces Preservation

The performance objective for exterior topside surfaces preservation is for the vessel's responsible party to prevent the discharge of rust (and other corrosion by-products), cleaning compounds, paint chips, non-skid material fragments, and other materials associated with exterior topside surface preservation that may negatively impact water quality.

Examples of activities that could be performed to meet the performance objective of exterior topside surfaces preservation include:

- Performing general housekeeping, such as sweeping and/or mopping, on the affected areas;
- Using drop cloths when removing and applying paints; and
- Using vacuum-assisted needle guns, sanders, and grinders.

2.6 Vessels, Aircraft, and Vehicles Refueling and Lubrication

Refueling and lubrication of vessels, aircraft, and vehicles generate traces of oil, grease, antifreeze, hydraulic fluids, and fuel constituents that can contribute to deck runoff. The type and extent of potential constituents discharged depends largely on the vessel class and area of operation. For example, aircraft carriers do not transport aircraft inside 12 nm; therefore, the risk of deck runoff discharged within 12 nm having constituents from aircraft lubrication is reduced, assuming materials deposited on the deck during refueling and lubrication operations outside of 12 nm are effectively removed and cleaned. Precipitation and green water are the primary sources of liquid discharge that can entrain constituents from these deck runoff processes.

Current practices for refueling and lubrication activities in Navy and MSC vessels are described in NSTM Chapter 541 *Ship Fuel and Fuel Systems* (Navy, 1996a), Chapter 542 *Gasoline and JP-5 Fuel System* (Navy 1997a), Chapter 571 *Underway Replenishment* (Navy, 1994), and Chapter 262 *Lubricating Oils, Greases, Specialty Lubricants and Lubricating Systems* (Navy, 1999b). The USCG refueling and lubrication practices are described in COMDTINST M9000.6D, Naval Engineering Manual (USCG, 2000a).

Five processes contribute constituents to this category of deck runoff discharge: (1) aircraft refueling; (2) fixed wing aircraft maintenance and operations; (3) fuel transfer systems; (4) ground support equipment; and (5) rotary wing aircraft maintenance and operation. The generation of constituents by these five processes is described in Section 2.6.1 to 2.6.5.

2.6.1 Aircraft Refueling

Vessels that refuel aircraft are classified as either aviation ships (e.g., aircraft carriers) or air capable ships, (e.g., destroyers and cutters). Armed Forces air capable ships are listed in OPNAVINST 3120.35J (Navy, 2000). These vessels range in size from large surface combatants (e.g., DDG 51) to 210 ft USCG medium endurance cutters (WMEC 210). Most aircraft refueling occurs while the aircraft are on deck. However, some vessel classes, such as the DDG 51, FFG 7, and WHEC 378 have helicopter in-flight refueling (HIFR) capabilities.

Aircraft refueling activities can occur inside and outside 12 nm. The only jet fuel authorized for use aboard Navy ships and transport by fleet oilers is JP-5 jet fuel, which is a middle distillate specially blended kerosene (Navy, 1996a). Sources of JP-5 spills include aircraft tank vents, tank relief valves, and fueling station drains. On aircraft carriers (CVN and CV Classes), which are the vessels with largest number of aircraft (85 aircraft per carrier), an average of approximately 20 gal of JP-5 spills during a 24-hour period of aircraft operation. Dedicated spill carts recover JP-5 from the deck on aircraft carriers and amphibious assault ships. However, the efficiency of this recovery method has not been determined. Small amounts of JP-5 residues may contribute constituents to deck runoff inside and outside 12 nm.

2.6.2. Fixed Wing Aircraft Maintenance and Operations

Only the Navy aircraft carriers (CV and CVN Class designation) and amphibious assault ships (LHD 1 and LHA 1 Classes) carry fixed wing aircraft. Typical aircraft maintenance procedures that can produce deck runoff constituents include repairs to hydraulic lines and aircraft lubrication. Although leaks and spills of hydraulic fluid (MIL-PRF-83282D) and aircraft grease (MIL-PRF-81322F) are cleaned up as soon as they are detected, the possibility exists for trace amounts to remain on deck and contribute to deck runoff discharge inside and outside 12 nm.

2.6.3 Fuel Transfer Systems

Fuel transfer includes the replenishment of fuel to a vessel while pierside, fueling-at-sea (FAS), and the refueling and de-fueling of small boats onboard ships. Armed Forces vessels use three types of fuels: (1) motor gasoline (MOGAS); (2) JP-5; and (3) F-76 (MIL-F-16884J).

MOGAS is used to power spark ignition engines, predominantly outboard engines on small boats and combat vehicles. Compensated MOGAS systems are installed on some amphibious ships that require the transfer of large quantities of MOGAS for combat vehicles. Because of the low flash point and high risk of explosion of MOGAS, smaller quantities of MOGAS, (e.g., used to supply small boats and craft) are stored in an outside fixed system. These systems are described in NSTM Chapter 670, *Stowage, Handling, and Disposal of Hazardous General Use Consumables* (Navy, 1997b). The transfer of MOGAS between on deck systems and boats can occur anywhere inside or outside 12 nm.

In addition to its role as jet fuel for aircraft (see Section 2.6.1), JP-5 is used in compression ignition engines of small boats and craft, and is an acceptable substitute for F-76 in ship’s compression ignition (CI) engines, gas turbines, and boilers. The transfer of JP-5 from on deck systems to boats can occur anywhere inside or outside 12 nm.

F-76, a type of kerosene distillate formerly known as diesel fuel marine (DFM), is the primary fuel used in Naval shipboard power plants including diesels, gas turbines, and boilers (Navy, 1996a). Small amounts of F-76 may spill on the weather deck of a vessel during pierside fuel transfer operations or while fueling or de-fueling boats and craft powered by CI engines, and therefore, may contribute constituents to deck runoff discharges. However, FAS between vessels only occurs while underway outside 12 nm and therefore is not expected to contribute deck runoff constituents inside 12 nm.

In addition to fuels, general purpose grease (MIL-G-24139A) can be a source of deck runoff constituents during FAS activities. This grease lubricates the wire ropes used for the transfer of fuel lines between vessels.

To a minor extent, JP-8 fuel (MIL-DTL-83133E) can be an additional source of deck runoff constituents. JP-8 is used to power various types of equipment that is transported on the weather deck of Army vessels (U.S. Army, 1997). The transfer of JP-8 from on deck systems to cargo is unlikely to occur on the vessel. However, cargo occasionally may leak trace amounts of JP-8 on to the weather deck. Although spills and leaks are immediately cleaned up after detection, some fuel constituents may remain trapped in the rough deck surface and have the potential to contribute to deck runoff.

2.6.4 Ground Support Equipment

Ground support equipment is comprised of vehicles and associated machinery used to move, start, and load aircraft. This equipment is mostly found on large aviation and air capable ships (e.g., CVN and LHD Classes). The main sources of constituents to deck runoff from this equipment are incidental leaks of hydraulic fluid (MIL-PRF-83282D) and engine oil (MIL-L-2104). Other sources of constituents include Dextron II automatic transmission fluid (SAE J2362), Dextron III automatic transmission fluid (no military specification), hydraulic fluid (MIL-L-17331H), power transmission fluid (MIL-F-17111), and A-A-52624A antifreeze (no military specification). Although leaks and spills are immediately cleaned after detection, the possibility exists for trace small amounts to remain on deck and contribute to deck runoff discharge.

2.6.5 Rotary Wing Aircraft Maintenance and Operation

Rotary wing aircraft operate from aviation and air capable ships that range from large aircraft carriers (CVN 68) to USCG medium endurance cutters (WMEC 210 Class). Most rotary wing operations from Navy vessels occur outside 12 nm, with training operations occurring inside 12 nm. USCG vessels routinely operate rotary wing aircraft inside and outside 12 nm.

Rotary wing aircraft operations and procedures that can produce deck runoff constituents include lubrication and repairs to hydraulic lines. The hydraulic fluid (MIL-PRF-83282D) used in rotary wing aircraft contains more than 65 % synthetic hydrocarbon base oil and less than 35 % lubricant ester base. Aircraft greases (e.g., MIL-PRF-81322F and MIL-PRF-23827C) are applied to struts, doors, and the rotor head at different time intervals that range from 24 hours to 56 days, depending on the lubricated component and frequency of aircraft deployment (see Section 2.3.1. for constituents from aircraft hydraulic fluids and greases). MIL-PRF-23699F oil is used to lubricate rotary wing engines. This oil may fall or wash onto the deck through normal operations. Although any lubricant or hydraulic fuel that falls on deck is immediately cleaned, constituents may be trapped in the deck surface and contribute to deck runoff discharges inside 12 nm.

2.6.6 Performance Objective: Vessel, Aircraft, and Vehicle Refueling and Lubrication

The performance objective for vessel, aircraft, and vehicle refueling and lubrication is for the vessel’s responsible party to prevent the discharge of anti-freeze compounds, fuels, hydraulic fluids, oils, greases, and other materials associated with vessel, aircraft, and vehicle refueling and lubrication that may negatively impact water quality.

Examples of activities that could be performed to meet the performance objective of vessel, aircraft, and vehicle refueling and lubrication include:

- Minimizing vessel, aircraft, and vehicle refueling inside 12 nm; and
- Performing hose blowdown or applying back suction to drain the hose.

Although other activities could be included in a vessel's TMP (e.g., avoid over application of lubricants and installing high visibility information placards at fueling stations), this report analyzes only the activities listed above.

3.0 Comparison to Narrative Water Quality Criteria

Deck runoff consists of water and entrained constituents for all topside processes that occur on a deck of a ship. Day-to-day and ship-to-ship composition and volume of the discharge are highly variable. Therefore, methods described in the EEA Guidance Manual could not be implemented (EPA and DOD, 2000b). Only comparisons to narrative water quality criteria (WQC), as described in Task 2 of the EEA Guidance Manual, were possible.

The six categories of topside process that contribute constituents to deck runoff were evaluated against 12 saltwater and eight freshwater narrative WQC. State criteria for nutrients, pathogens, and oil and grease exist for both freshwater and saltwater systems; however the criteria have different endpoints (see Appendix A for details). Constituents from each of the six categories of topside processes can potentially cause the discharge to exceed one or more narrative WQC (as summarized in Appendix B). However, the six categories of topside processes are not expected to exceed six saltwater and seven freshwater WQC endpoints.

Sections 3.1.1 to 3.1.11 describe narrative WQC not expected to be exceeded by any of the six categories of topside process that contribute constituents to deck runoff. Sections 3.2.1 to 3.2.6 describe, for each of the categories of topside process, the expected narrative WQC to be exceeded by the baseline- or topside management plan-controlled discharge.

Appendix A presents the EEA endpoints for the 12 saltwater and six freshwater narrative criteria. Appendix B summarizes the potential baseline and topside management plan WQC exceedances of the six deck runoff processes.

3.1 Narrative WQC Not Expected to be Exceeded by Deck Runoff Process

Sections 3.1.1 to 3.1.11 provide the rationale and conclusion for each narrative WQC that is not likely to be exceeded due to contributions by any of the six categories of deck runoff processes. The narrative WQC not exceeded are alkalinity, BOD/DO, hardness, nutrients, odor, pathogens, pH, specific conductance, taste, temperature, and total dissolved solids.

3.1.1 Alkalinity

Narrative criteria for alkalinity are freshwater State regulatory limits that describe the pH buffering capacity of a water body in milligrams per liter of equivalent calcium carbonate. Aquatic systems with low alkalinity tend to have low concentration of carbonates (e.g., calcium carbonate, magnesium carbonate), and are susceptible to pH fluctuations from events such as acid rain and acidic industrial wastes. The EEA endpoint for alkalinity specifies that the discharge shall not (1) lower receiving water alkalinity below 20 mg/L; or (2) further reduce the alkalinity of receiving water with an alkalinity of 20 mg/L or less. In general, deck runoff could carry constituents from salt and corrosion deposits, oil, grease, traces of fuel, hydraulic fluid, paint fragments, and cleaning compounds. None of the constituents identified from any of the deck runoff processes are expected to significantly decrease the carbonate concentration and reduce the buffering capacity of receiving waters. Therefore, deck runoff is not expected to exceed alkalinity WQC.

3.1.2 BOD/DO

Narrative criteria for biochemical oxygen demand/dissolved oxygen (BOD/DO) are State regulatory limits related to the ability of an aquatic system to maintain adequate oxygen levels to sustain aerobic organisms. High BOD can result from discharges with a high content of organic matter (e.g., untreated sewage effluents) that, through oxidative processes, can cause a detrimental decrease of dissolved oxygen in receiving waters. Low dissolved oxygen levels can also occur if the liquid discharge has become anoxic (oxygen-depleted) through biological or chemical processes prior to its release. The EEA endpoint for BOD/DO specifies that the discharge shall not depress receiving water dissolved oxygen concentration by more than 10 %, or to a level that produces nuisance conditions. In general, deck runoff could carry constituents from salt and corrosion deposits, oil, grease, traces of fuel, hydraulic fluid, paint fragments, and cleaning compounds. Traces of human waste also may be present in deck runoff discharge when a vessel, usually a USCG Cutter, temporarily holds large numbers of detained migrants on deck. This waste material is the only source of organic constituents in deck runoff discharge that could fuel rapid biological or chemical oxidative processes and have the potential to increase the BOD or reduce the DO of receiving waters. Migrant interdiction and rescue operations generally occur in open waters outside 12 nm, where surface water turbulence from natural wave action and the ship’s propulsion system rapidly mix the discharge and aerate the receiving waters. During these operations traces of waste material may be trapped in the rough deck surfaces, and could contribute to deck runoff discharge inside 12 nm. The amount of human material trapped in the rough deck surfaces was not quantified, however because they are considered trace amounts, it should not affect the BOD or DO levels of receiving waters inside 12 nm. Therefore, deck runoff is not expected to exceed BOD/DO WQC.

3.1.3 Hardness

Narrative criteria for hardness are freshwater State regulatory limits of polyvalent cations dissolved in the water. One of the undesirable effects from excessive hardness is that it can impart objectionable tastes to drinking water. The main contributors to water hardness are Ca^{2+} and Mg^{2+} ions from calcium and magnesium salts (e.g., calcium and magnesium bicarbonates, carbonates, sulfates, chlorides, and nitrates). The EEA endpoint for hardness specifies that the discharge shall not cause receiving water hardness to exceed 100 mg/L as calcium carbonate ($CaCO_3$). In general, deck runoff can contain constituents from salt and corrosion deposits, oil, grease, traces of fuel, hydraulic fluid, paint fragments, and cleaning compounds. None of the identified deck runoff processes contribute significant concentrations of dissolved polyvalent cations. Therefore, deck runoff discharge is not expected to cause receiving waters to exceed 100 mg/L of $CaCO_3$ at the end of mixing zone (EOMZ) and is expected to pass the hardness WQC.

3.1.4 Nutrients

Narrative criteria for nutrients are regulatory freshwater and saltwater limits of inorganic nitrogen and phosphorous. Aquatic ecosystems with excess nutrients can have accelerated plant production that may lead to detrimental euthrophic conditions (e.g., anoxic waters, loss of water transparency). For saltwater systems, the EEA evaluation endpoint is that the end-of-pipe (EOP) discharge shall not exceed 300 μg/L total nitrogen (nitrate + nitrite + KJN), 10.0 μg/L of ammonia nitrogen, 15 μg/L nitrate + nitrite, or 60.0 μg/L of total phosphorus. The EEA freshwater evaluation endpoint is that discharge should not cause the receiving water phosphorus concentration to exceed 50 μg/L.

Deck runoff can carry constituents from salt and corrosion deposits, oil, grease, traces of fuel, hydraulic fluid, paint fragments, and cleaning compounds. With the exception of traces of human waste that may be present when a vessel, usually a USCG Cutter, holds large numbers of detained migrants on deck, none of the constituents associated with deck runoff processes are expected to be a significant source of nutrients to the receiving waters. Migrant interdiction and rescue operations generally occur in open waters outside 12 nm. During these operations traces of waste material may be trapped in the rough deck surfaces, and could contribute to deck runoff discharge inside 12 nm. The amount of human material trapped in the rough deck surfaces was not quantified, however because they are considered trace amounts they are not expected to result insignificant release of nutrients to receiving waters inside 12 nm that will exceed the EEA evaluation endpoints. Deck runoff is not expected to exceed nutrients WQC.

3.1.5 Odor

Narrative criteria for odor are State freshwater regulatory limits evaluated in EEAs by the detection of offensive odors or by the comparison of constituent concentration to recommended Federal WQC for organoleptic effect (EPA and DOD, 2000b; EPA, 1999). Exceedance of organoleptic criteria assumes that the discharge has the potential to (1) impart unpalatable flavor to food fish or (2) result in offensive odors in the vicinity of the receiving water. The UNDS deck runoff Shipboard Survey Team never recorded a detectable offensive odor while conducting the survey of vessels. From the list of organoleptic criteria constituents, only zinc and copper are known to occur in deck runoff. The recommended organoleptic WQC for copper is 1000 μg/L; for zinc is 5000 μg/L. Ablative antifouling paint fragments released while cleaning buoys are a source of copper and zinc. The other known potential source of zinc is anti-seize compound used in the ARLE system. The actual concentration of these metals in the deck runoff discharge cannot be ascertained. However, the sources of both metals are relatively small (see section 2.1 and 2.2 for details) and are not expected to cause the receiving waters to exceed the recommended organoleptic WQC concentrations. Therefore, because there is no detectable odor associated with the discharge, and none of the organoleptic constituents are likely to exceed the EPA criteria, deck runoff is expected to pass the odor WQC.

3.1.6 Pathogens

Narrative criteria for pathogens are State regulatory limits, above which are potentially harmful to human health. The EEA saltwater evaluation endpoint specifies that the discharge shall not cause receiving water to exceed at the EOMZ: (1) a geometric mean of 8 enterococci/100 mL or an instantaneous level of 54 enterococci/100 mL; (2) a geometric mean of 126 *E. coli*/100 mL, or an instantaneous level of 406 *E. coli*/100 mL; or (3) 50 fecal coliform/100 mL by any measure or calculation. The EEA freshwater evaluation endpoint is that the discharge shall not cause receiving water to exceed (1) a geometric mean of 20 fecal coliform/100 ml, or (2) exceed a geometric mean of 125 *E. coli*/100 ml. In general, deck runoff can carry constituents from salt and corrosion deposits, oil, grease, traces of fuel, hydraulic fluid, paint fragments, and cleaning compounds. Small amounts of human waste also may be present in deck runoff discharge when a vessel, usually a USCG Cutter, temporarily holds large numbers of detained migrants on deck. Human waste material is the only known potential source of pathogens in deck runoff discharge. Migrant interdiction and rescue operations generally occur in open waters outside 12 nm where surface water turbulence from natural wave action and the ship's propulsion system rapidly mix the discharge. During these operations, traces of human waste material may be trapped in the rough deck surfaces, and could contribute to deck runoff discharge inside 12 nm. However, the environmental conditions of the weather deck rough surfaces (e.g., exposure to solar irradiation and salt accumulation) are not expected to foster the survival of pathogens. As result of the expected small amounts of human waste and unfavorable conditions for pathogen survival in the deck rough surfaces, the deck runoff discharge is unlikely to contribute significant amounts of pathogens to receiving waters that will exceed the EEA endpoints. Therefore, the discharge is not expected to exceed pathogen WQC.

3.1.7 pH

Narrative criteria for pH are State regulatory definitions of the discharge's allowable pH range and/or the resulting change in receiving water's pH. The EEA endpoints for pH specifies that the discharge shall not (1) be less than 6.5 at EOP, (2) be greater than 9.0 at EOP, or (3) cause a receiving water change of greater than 0.5 pH units at EOMZ. In general, deck runoff can carry constituents from salt and corrosion deposits, oil, grease, traces of fuel, hydraulic fluid, paint fragments, and cleaning compounds. None of the constituents identified with deck runoff processes include significant quantities of acidic or basic substances that could cause the discharge to exceed the EEA EOP endpoints or to significantly affect the overall pH of the receiving waters. Therefore, deck runoff is not expected to exceed pH WQC.

3.1.8 Specific Conductance

Narrative criteria for specific conductance are State freshwater regulatory limits on how much a discharge can affect the electrical conductance of receiving water from releases of dissolved ionic substances. These criteria are often used by States to regulate the intrusion of saltwater into a freshwater system. The EEA endpoint for specific conductance specifies that the discharge shall not raise EOMZ conductivity of receiving water above 1000 micromhos/cm. In general, deck runoff processes produce constituents from salt and corrosion deposits, oil, grease, traces of fuel, hydraulic fluid, paint fragments, and cleaning compounds. Of these constituents, salts and corrosion deposits are expected to be the major sources of free ions to receiving waters. However, salt deposits are expected to occur most often on vessels that operate in saltwater where these narrative criteria do not apply. The corrosive deposits are expected to be small amounts of metal oxides that should not significantly affect the specific conductance of receiving water at the EOMZ 35 m limit. Therefore, deck runoff is not expected to exceed the specific conductance WQC.

3.1.9 Taste

Narrative criteria for taste are State regulatory limits, evaluated in EEAs by comparison to recommended Federal WQC for organoleptic effects (EPA and DOD, 2000b; EPA, 1999). Exceedance of organoleptic criteria assumes that the discharge has the potential to impart unpalatable flavor to food fish. Of the list of organoleptic criteria constituents, only zinc and copper are known to occur in deck runoff. The recommended organoleptic WQC for copper is 1000 μg/L; for zinc is 5000 μg/L. Ablative antifouling paint fragments released while cleaning buoys are a source of copper and zinc. The other known potential source of zinc is anti-seize compound used in the ARLE system. Actual concentrations of these metal in the deck runoff discharge cannot be ascertained. However, the sources of both metals are relatively small(e.g., less than two gallons of anti-seize compound used per aircraft carrier per year) and are not expected to exceed the recommended organoleptic WQC concentrations. Therefore, deck runoff is not expected to exceed taste WQC.

3.1.10 Temperature

Narrative criteria for temperature are State regulatory limits on the increase in temperature of receiving waters. A significant increase in receiving water temperature can have negative environmental effects due to changes in biological and chemical processes. The EEA endpoint for temperature specifies that the discharge will not cause EOMZ temperature to increase more than 0.3°C. In general, deck runoff is primarily composed of green water and precipitation. Because these sources are not used as a cooling medium, the discharge is not expected to have a temperature that is significantly greater than that of receiving waters. Therefore, the discharge is not expected to cause the EOMZ temperature to increase more than 0.3°C. Deck runoff is therefore not expected to exceed the temperature WQC.

3.1.11 Total Dissolved Solids

Narrative criteria for total dissolved solids (TDS) are State regulatory limits for freshwater that specify the mass of minerals, salts, metals, or organic matter dissolved in water. Comparisons to the criteria are used as indicators of general water quality. The EEA endpoints for TDS specify that the discharge shall not cause the receiving water TDS concentration to exceed 400 mg/L. In general, deck runoff can carry constituents from salt and corrosion deposits, oil, grease, traces of fuel, hydraulic fluid, paint fragments, and cleaning compounds. Of these constituents, salts and corrosion deposits are expected to be the primary sources of dissolved solids. However, salt deposits occur primarily in vessels that operate in saltwater where this narrative WQC does not apply, and ships decks are routinely kept clean of solids when ships are in or near ports. Corrosive deposits (e.g., metal oxides) are expected only in amounts that cannot be removed by routine cleaning. None of the processes are expected to contribute a loading of dissolved solids that would cause the 400 mg/L criteria to be exceeded at the EOMZ. Therefore, deck runoff is not expected to exceed for total dissolved solids WQC.

3.2 Narrative WQC Exceeded by Deck Runoff Process

Sections 3.2.1 to 3.2.6 describe, for each of the categories of topside processes, the expected narrative WQC to be exceeded by the baseline or topside management plan controlled discharge. The baseline conditions of all the six categories of topside process are expected to exceed at least two narrative WQC (Appendix B). The narrative WQC for color is the only WQC expected to be exceeded by the baseline conditions of all of the six categories of topside process.

3.2.1 Narrative WQC: Aircraft Launch and Recovery Equipment Topside Operations

Approximately 55 % of the 120 grade lubricating oil currently used in catapult systems remains as sludge material after evaporation. This residue comprises approximately 96 % of the material accumulated in the catapult trough (Opet, 2000). When discharged to receiving waters, the sludge may cause a sheen and floating material while pierside, which results in an exceedance of the narrative WQC endpoints for oil and grease, color, and floating materials. Other materials used, such as high temperature grease, dry cleaning degreasing, and anti-seize compound can also contribute to the total amount of oil and grease released to receiving waters. Soot particles from the jet blast deflectors can potentially contribute floating material, suspended solids, and settleable material to deck runoff discharge.

The performance objective for this category is for the vessel's responsible party to prevent the discharge of oils, greases, solvents, soot, and other materials associated with ALRE that may negatively impact water quality. This objective could be attained by minimizing catapult test launches in port, cleaning and storing ALRE before returning to port, and using environmentally compliant lubricants for catapults.

With the exception of the no-load catapult test conducted before vessel deployment, all catapult ALRE operations are conducted outside 12 nm. A recent Naval message from Lakehurst Naval Air Warfare Center provides guidance that limits the number of no-load catapult shots in port to 10, and the application of lubricant only to the first shot (Navy, 1997c). Minimizing the number of catapult test launches in port and the application of lubricant should reduce the contribution of oil and grease to deck runoff and should reduce the incidence of sheens, floating material, suspended solids, and turbidity.

Another activity currently in place is the storing and cleaning of ALRE before returning to port. Cleaning and storing ALRE before returning to port will protect this equipment from the weather, reducing the potential for oil and grease to contribute constituents to the deck runoff. The implementation of this activity should lower the incidence of sheens, floating material, suspended solids, settleable material, and turbidity.

The Navy is currently in the process of replacing the 120 grade lubricant with an environmentally compliant lubricant for catapults (Grajek, 2000). The principal ingredient in this environmentally compliant lubricant for catapults is polyoxypropylene glycol mono butyl ether. This relatively non-toxic lubricant is a slightly water-soluble synthetic oil, originally developed and approved for use as a lubricant for metallic surfaces intended to come into contact with food (Opet, 2000). This new lubricant leaves approximately 2 % residue, compared to 55 % residue from the 120 grade lubricant; therefore, the environmental compliant lubricant for catapults should significantly reduce the amount of sludge and floating material, and may reduce the potential to cause a sheens when discharged to receiving waters.

It is therefore expected that with the full implementation of the TMP activities, ALRE operations will not be a significant source of deck runoff constituents that would cause an exceedance of the oil and grease, floating materials, and/or color narrative WQC endpoints.

3.2.2 Narrative WQC: Buoy Maintenance

Buoy maintenance releases suspended solids and settleable material, which may cause turbidity and affect the transparency and color of the receiving waters. This process produces a small volume of liquid discharge (approximately 2,000 gal of firemain water per day) and associated debris (about 4 gal of debris per buoy). Because of turbulence created by vessel bow thruster and propulsion plant station-keeping operation, the effects from the discharge are expected to be ephemeral and limited to the receiving waters within the 35 m mixing zone defined by the EEA guidance. With the exception of paint chips and rust, all suspended and settleable materials discharged by buoy handling activities are indigenous to the receiving waters. Other environmental parameters such as nutrients, BOD/DO, and temperature should not be affected by the maintenance and preservation of navigational buoys. Due to the high concentration of copper and zinc used in ablative antifouling paints, the discharge may exceed numeric WQC for either metal. However, because actual measurements were not taken, an accurate evaluation was not possible.

The performance objective for this category is for the vessel's responsible party to prevent the discharge of rust, paint chips, paint drips, cleaning compounds, and other material associated with buoy maintenance that may negative impact water quality. This objective could be attained by using high-pressure washers in lieu of metal scrapers, conducting only minor buoy repairs underway, and discharging biofouling material and sediments from where the buoy was hauled for maintenance and/or repair.

Using high-pressure washers instead of scrapers should reduce the discharge of rust and paint chips into the receiving waters from buoy maintenance activities. High-pressure washers primarily remove marine biofouling, releasing only minor amounts of paint and rust compared to using a scraper. Buoy maintenance releases suspended solids and settleable material, which may increase turbidity and affect the transparency and color of the receiving waters. Using pressure washers should prevent the exceedance of settleable materials WQC, because almost all the material produced would be of natural origin (e.g., encrusting biofouling organisms). However this practice will not prevent the exceedance of suspended solids, color, and turbidity narrative WQC.

Only minor buoy repairs are conducted underway. All major buoy repairs are conducted ashore. Conducting major buoy repairs shoreside should reduce the amount of settleable materials and suspended solids available to contribute to deck runoff. However, it could not be ascertained whether the full implementation of the TMP practices would prevent exceedance of suspended solids, color, and turbidity narrative WQC.

3.2.3 Narrative WQC: Cleaning Activities/General Housekeeping

Cleaning and general housekeeping activities can produce deck runoff discharge with traces of oil, grease, and hydraulic fluids that may cause a failure of oil and grease, and color narrative

WQC endpoints. In addition, the discharge may have cleaners and emulsified hydrocarbons. Cleaning of aircraft engines can release gas path, oil, grease, and fuel constituents; however, such discharges generally occur outside 12 nm, and are not significant contributors to deck runoff inside 12 nm. It is also possible for minute amounts of paint chip fragments to be released during the scrubbing of decks. However, these particles should not cause noticeable amounts of settleable materials. Other environmental parameters such as nutrients, BOD/DO, and temperature should not be affected by cleaning and general housekeeping activities.

The performance objective for cleaning activities/general housekeeping is for the vessel's responsible party to prevent the discharge of cleaning compounds, hydraulic fluids, oils, fuels, greases, dirt, salts, soot, and other materials associated with cleaning activities/general housekeeping that may negatively impact water quality. These objectives could be attained by (a) minimizing cleaning of aircraft, ETSs, equipment, and vehicles within 12 nm; (b) using a vacuum to remove water from aircraft washdowns conducted outside 12 nm; (c) using flight deck scrubbers and (d) cleaning tie-down fixture with vacuums. All these practices are currently in-place on Armed Forces vessels.

Ships reduce the amount of grease, oils, soot, and cleaning compounds that contribute to deck runoff inside 12 nm by conducting as much topside cleaning outside 12 nm as possible. Vacuuming deck tie down fixtures during washdowns reduces the amount of cleaning compounds, oil, grease, dirt, and soot by collecting these constituents before they can be washed off the deck inside 12 nm. Using flight deck scrubbers reduces the oil, grease, dirt, cleaning compounds, and soot that contribute to deck runoff by removing the constituents before they can be washed off the deck inside 12 nm. Collectively, these cleaning activities and housekeeping procedures should reduce the potential for exceedance of oil and grease, floating materials, settleable materials, suspended solids, and turbidity narrative WQC.

3.2.4 Narrative WQC: Deck Machinery and Weapons Lubrication

Lubrication of deck machinery and weapons may result in the release of constituents from oil, grease, hydraulic fluids, and degreasers that can be entrained in the deck runoff discharge. Although any hydraulic fluid, and oil or grease that leaks or spills is cleaned immediately upon detection, the potential exists for trace amounts to remain on the deck and contribute to deck runoff both inside and outside 12 nm. This potential results in a failure of oil and grease and color WQC endpoints. Other environmental parameters, such as nutrients, BOD/DO, suspended solids, settleable material, and temperature are not expected to be affected by the lubrication of deck machinery and weapons.

The performance objective for this category states that the vessel's responsible party is to prevent the discharge of cleaning compounds, greases, hydraulic fluids, solvents, oils, fuels, and other materials associated with deck machinery and weapons lubrication that may negatively impact water quality.

Activities identified that could be performed to meet this objectives include: using a wire rope lubricator and using covers or protective devices such as chafing guards at friction points on exposed hydraulic hoses; extensions on winch engine oil drains; fitted covers on cranes and mounts/weapons, sample fittings on winch engines; and tarps during equipment maintenance.

Wire rope lubricators reduce the application of excess grease and minimize generation of cleaning rags soiled with grease, which are considered a hazardous solid waste. These activities reduce the potential for grease to fall onto the deck and subsequently contribute to deck runoff. This activity should reduce the potential to exceed oil and grease narrative WQC.

The use of covers and protective devices limits the contribution of oil and grease constituents to deck runoff. By shielding the equipment from the weather, covers and protective devices should prevent oil and grease from falling, being blown, or washed to the deck. This reduction in contribution of oil and grease to deck runoff should reduce the potential to exceed oil and grease WQC.

Using tarps during equipment maintenance should control the release of oil and grease constituents. Appendix L of OPNAVINST 5090 specifies that items such as rags contaminated with oil are oily solid waste that must be containerized for shore disposal (Navy, 1999a). The use of tarps to collect falling grease and oil during equipment maintenance should reduce the potential for exceedance of the oil and grease narrative WQC.

Lubrication of deck systems is conducted on various vessel classes. Therefore, the degree of effectiveness of proposed TMP activities would be vessel class specific. However, it is expected that these activities will control the release of oil and grease constituents to some extent for all vessel classes. Therefore, the full implementation of these practices will reduce the potential for exceedance of color, and oil and grease, WQC.

3.2.5 Narrative WQC: Exterior Topside Surface Preservation

Preservation of exterior surfaces releases paint chips and associated debris (e.g., non-skid material fragments and rust). These fragments are settleable material that can potentially cause turbidity and affect the transparency and color of the receiving waters.

The performance objective for exterior topside surface preservation is for the vessel’s responsible party to prevent the discharge of rust (and other corrosion by-products), cleaning compounds, paint chips, non-skid material fragments and other materials associated with exterior topside surface preservation that may negatively impact water quality. These objectives could be attained by (a) performing general housekeeping (see section 3.4); (b) using drop cloths when removing and applying paints; and (c) using vacuum-assisted needle guns, sanders and grinders.

Performing general housekeeping, including sweeping, vacuuming, and swabbing with or without detergent reduces the contribution of rust, paint chips, paint drips, and cleaning compounds to deck runoff. Although general housekeeping has the potential to minimize the constituents available on deck that can become entrained in the waste stream, it may slightly increase the contribution of cleaners (e.g., Simple Green™) to deck runoff. Overall however, general housekeeping should reduce the impacts to color, settleable material, and turbidity of receiving waters.

Using drop cloths when removing and applying paint reduces the contribution of paint chips, rust, dust, and paint drips to deck runoff. Drop cloths collect these constituents, preventing them from falling to the deck. This activity has the potential to reduce impacts to the color, suspended solids, and turbidity of receiving waters. Current instructions (e.g., Appendix L of OPNAVINST 5090) require collection of paint chips and associated debris for on-shore disposal.

Vacuum-assisted tools used during paint removal collect the associated debris for appropriate on-shore disposal, reducing overboard discharge of rust and paint chips, and therefore reduce impacts to color, settleable material, and turbidity of receiving waters.

Other environmental parameters such as nutrients, BOD/DO, and temperature should not be affected by the preservation of exterior surfaces. In conclusion, continuing to operate in accordance with the Naval Instructions currently in place and with the practices suggested in the TMP should reduce the potential for the exceedance of narrative water quality criteria.

3.2.6 Narrative WQC: Vessels, Aircraft, and Vehicles Refueling and Lubrication

Due to the nature of oil, grease, and fuel constituents generated by this topside process, the potential exists for incidental occurrences of sheens and discoloration of surface waters. Current OPNAVINST 5090 details safe procedures for oil handling and transfers as well as spill prevention, cleanup and response. Spill response includes the availability and use of an Oil Spill Containment and Cleanup kit. By complying with OPNAVINST 5090, receiving waters should not be substantially affected by constituents from vessels, aircraft, and vehicles refueling and lubrication activities, except in unusual circumstances (e.g. reportable spill events not regulated by UNDS). Therefore, liquid and solid constituents associated with refueling and lubrication activities are not expected to affect turbidity, transparency, color, or any other environmental parameters, such as nutrients, BOD/DO, and temperature. In conclusion, the refueling and lubrication of vessels, aircraft, and vehicles processes, when performed in accordance with OPNAVINST 5090 and other in-place procedures should control, but not eliminate potential exceedances of the color, and oil and grease narrative WQC.

The performance objective for vessels, aircraft, and vehicles refueling and lubrication is for the vessel’s responsible party to prevent the discharge of anti-freeze compounds, fuels, hydraulic fluids, oils, greases, and other materials associated with vessel, aircraft, and vehicle refueling and lubrication that may negatively impact water quality. This objective could be achieved by: (a) minimizing aircraft, vessel, and vehicle refueling inside 12 nm; (b) performing hose blow down or applying back suction to drain the hose.

Minimizing aircraft, vessel, and vehicle refueling inside 12 nm reduces the amount of fuel and oil that contribute to deck runoff because the spilled fuel occurring outside 12 nm is immediately cleaned from the deck before the vessel transits inside 12 nm. This activity should reduce the potential for exceedance of oil and grease, and color narrative WQC.

Performing hose blowdown or applying back suction to drain fuel hoses reduces the fuel left in refueling hoses and therefore reduces the potential for a fuel spill and the subsequent contributions of fuel to deck runoff. Preventing fuel spills decreases the potential exceedance of oil and grease, color, and turbidity narrative WQC.

4.0 Introduction of Non-Indigenous Species

Deck runoff discharge is not expected to provide a viable mechanism for the introduction of non-indigenous species (NIS). The sources of deck runoff are precipitation, green water, and washdowns that fall on the weather deck of a vessel. Precipitation is not a source of non-indigenous species. It is unlikely that greenwater will be retained on the weather deck under conditions suitable for the transfer of viable populations of NIS microorganisms (e.g., dinoflagellates). Washdowns, include the maintenance of navigational buoys and general housekeeping of the weather deck. The firemain water used to clean the buoy tender working deck does not present a risk for introduction of NIS. Buoy tenders are equipped with dry firemain systems that do not hold large volumes of water for extended periods that could harbor and foster the translocation of large, viable populations of NIS (e.g., dinoflagellates). Freshwater used for cleaning and general housekeeping during deck washdown is not a source of NIS. Furthermore, during normal buoy maintenance operations, buoy tenders remain within the same ecological area of the buoy station. For the purpose of this document an ecological area is defined as a continuous aquatic system not impeded by physiographical or ecological barriers (e.g., levees, dams, gates, salinity, temperature, depth) that would prevent the natural transport and dispersal of aquatic biota by either active organism locomotion or drifting with current or tidal flows. Therefore, marine organisms and sediments removed from the surface of the buoys are returned to their native environment.

5.0 Bioaccumulative Contaminants of Concern

Four bioaccumulative contaminants of concern (BCC) have been identified as potentially present in deck runoff (Table 2). Two of the identified BCCs are metals (copper and zinc), and two are organic compounds (PAH and naphthalene).

Table 2. BCC Potentially Present in Deck Runoff

BCC	CAS Number	Elimination (E) Reduction (R)	Source
Copper	7440508	R	Buoy's ablative antifouling paints
Zinc	7440666	R	Buoy's ablative antifouling paints, anti-seize compound used with arresting gear and jet blast deflectors
Naphthalene	91203	R	Aircraft engine water wash, and fuels
PAHs		R	Traces amounts from fuels

Paint chips from ablative antifouling paints contain copper and zinc. These metals are found as oxides dispersed in the paint matrix. In this form, the water solubility and the propensity for bioaccumulation are low. These ablative antifouling paints contain a mass fraction of approximately 47 % copper as copper (I) oxide (cuprous oxide) and a mass fraction of approximately 15 % zinc as zinc oxide. In addition, zinc is also found in the anti-seize compound used for arresting gear and jet blast deflectors.

The zinc in the anti-seize compound is found as suspended powder in a petrolatum or mineral oil matrix (Navy, 1999a). Military specifications do not indicate a minimum or maximum concentration of zinc in anti-seize compound; therefore, the concentration of zinc cannot be quantified. The annual volume of anti-seize compound used in arresting gear throughout the fleet is approximately 20 gal/yr, or less than two gallons per aircraft carrier per year, which is very low when compared to other lubricants used throughout the fleet. For example, the volume of anti-seize compound used is less than 1 % of the volume of arresting gear grease and oil used. Therefore, because of its limited use and relative low volume, anti-seize compound is not considered a major source of zinc. However, to the extent possible, the use of BCC-free compounds will be promoted.

Naphthalene is a constituent of gas path cleaners used during aircraft engine wash and is also found in JP-5. Current Navy instructions prohibit the discharge of engine water wash inside 12 nm (Navy 1999a). Therefore, with the exception of trace small amounts that may be released during any process that involved the release of JP-5 constituents, naphthalene is not released inside 12 nm. In a similar situation, PAHs could be released during any process that potentially releases fuels on deck. The TMP practices designed to prevent the failure of oil and grease WQC will also prevent the release of naphthalene and PAH.

6.0 Other Potential Environmental Impacts

This section briefly describes the potential for other environmental impacts from deck runoff discharge. These impacts include effects to intertidal environments from chronic exposure to constituents from fuel, and oil and grease; long term effects from ablative antifouling paints; and production of nuisance species populations.

Sensitive intertidal environments (e.g., wetlands, seagrass beds, and coral reefs) in the vicinity of large homeports could be subject to chronic exposure by constituents from oil, grease, and fuel. For example, it has been demonstrated that chronic exposure to oil constituents can have sub-lethal impact to coral reefs particularly affecting reproduction and recruitment (Shigenaka, 2001). Constituents from oil, grease, and fuel, because of their predominantly low specific gravity, tend to accumulate in the water surface microlayer, which facilitates their transfer to emergent intertidal communities. The impacts to these communities will be location-specific and influenced by local hydrology, physiography, and climate.

Near-shore areas with limited circulation and flushing, within which a high number of ships and navigational buoys exist (e.g., some bays and estuaries), may accumulate paint chips in benthic sediments. The high copper concentration of the ablative antifouling paint chips may cause long-term impacts to the local benthic community through bioaccumulation and chronic effects. The most at-risk areas are embayments with low circulation and low sediment deposition, which would keep the paint chips near the upper sediment layers of the benthos. Upper layers of the benthos are typically very biologically and chemically active areas, characterized by high bioturbation and remineralization. The long-term risk of the potential accumulation of paint chip constituents in the benthos cannot be quantified at this point.

Deck runoff is not expected to introduce or promote the establishment of nuisance species. Nuisance species can be non-indigenous species or indigenous species that negatively disrupt the dynamics of an ecosystem. Non-indigenous species are not expected to be introduced by deck runoff discharge (see Section 4.0). Populations of indigenous nuisance species typically develop as result of ecological stressors (e.g., excessive nutrient loading, removal of a keystone species); however these ecological stressors were not identified for deck runoff.

7.0 Uncertainty Analysis

The biggest source of EEA uncertainty is the high degree of variability of deck runoff processes among vessel classes. Each vessel class has different deck surface area profiles and characteristics, operational procedures, and machinery on its weather deck. The variability of these characteristic features, together with vessel size and operating location, influence the amount and composition of potential constituents carried by deck runoff. Some topside processes and associated machinery apply to a wide range of vessel classes. For example, vessels such as the latest Guided Missile Destroyers (DDG 51 Class) and Fast Combat Support Ships (AOE 6 Class) share some similar characteristics such as onboard rotary wing aircraft and two 20 mm Phalanx Close-In Weapon Systems. In other aspects, these two classes are very different. The AOE 6 Class has four 10 ton capacity cargo derricks, while the DDG 51 Class has no comparable equipment. Other vessels classes, such as the aircraft carriers, have very specialized systems on deck (e.g., ARLE) that affect deck runoff quality.

The mix of shared characteristics among multiple vessel classes, combined with the uniqueness of certain classes results in a wide range of expected constituent loadings that may be present in deck runoff. Furthermore, the expected constituent loadings may also vary significantly within a single vessel class. The particular climate and season of the operational area of a vessel is a major factor affecting the composition of the deck runoff discharge. Therefore, vessels assigned to tropical or subtropical areas (e.g., Hawaii and the Caribbean) experience different weathering processes than similar vessels assigned to more temperate locations (e.g., North Atlantic).

Deck runoff samples were not collected because the instances of runoff are infrequent, unpredictable, and highly variable because deck runoff is principally the result of adverse weather conditions. Because of this variability and the difficulty of gathering a representative sample, statistically valid sampling would be impractical. The absence of sample data prevents the comprehensive characterization of constituents in the deck runoff discharge, and thus increases the level of uncertainty of the EEA. Without sample data, all conclusions were based on process knowledge and technical references such as material safety data sheets (MSDS) and military specifications. MSDSs and equivalent data sources are not available for all substances that could contribute constituents to deck runoff. Furthermore, MSDSs only provide major constituents, and do not detail analytical information that would confirm or deny the presence of BCCs or their concentrations. In some instances, military specifications provide requirements for maximum or minimum amounts of a particular constituents in a material used, (e.g., chromium in topcoat paints). This type of information can help elucidate some of the potential constituents in deck runoff; however, it is not detailed enough to be used in numeric WQC evaluations.

To ensure that the TMP will adequately protect the environment, this EEAR assumed highest impact conditions from the characterization data. For example, the characterization information gives a visual estimate of 4 gal of debris produced during the cleaning of one buoy that consists of a wet matrix of biofouling organisms, sediments, and paint chips. This mass of debris has a high content of interstitial water, which if dried, will probably reduce its volume. Furthermore, the precise volume of paint chips was not quantified; it could be significantly lower than the estimated 1 % because buoys rarely require touch up painting. This indicates that the buoy’s paint coats are not frequently damaged and few paint chips are generated when the biofouling materials are scraped off during topside maintenance activities.

Other sources of uncertainty stemmed from the limited information available about the effectiveness of current in-place practices for the recovery and cleaning of material that falls on deck, and the insufficient data to characterize how constituents on a vessel deck degrade and volatilize through normal weathering processes. Understanding the weathering process would help with the assessment of the actual composition of constituents entrained in deck runoff discharges. Without this information, accurate mass loading estimates are not possible.

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Appendix A

Endpoints for State Benchmark Narrative Water Quality Criteria Categories

SALTWATER	EEA ENDPOINT
BOD/DO	The discharge shall not depress receiving water dissolved oxygen concentration (1) by more than 10%, or (2) to a level that produces nuisance conditions.
Color	The discharge shall not (1) exceed 15 color units at EOP, and (2) exceed natural conditions or be visually noticeable in the receiving water.
Floating Materials	The discharge shall not release or create floating solids in the receiving waters.
Nutrients	The discharge shall not exceed 300 μg/L total nitrogen (nitrate + nitrite + KJN), 10.0 μg/L of ammonia nitrogen, 15 μg/L nitrate + nitrite, or 60.0 μg/L of total phosphorus at EOP
Odor	The discharge shall not (1) impart unpalatable flavor to food fish or (2) result in offensive odors in the vicinity of the receiving water.
Oil & Grease	The discharge shall not (1) have an EOP concentration of bulk oil and grease greater than 5 mg/L; (2) cause receiving water EOMZ concentration of bulk oil and grease greater than 15 μg/L; or (3) cause a sheen anywhere in the receiving water.
Pathogens	The discharge shall not cause receiving water to exceed at the EOMZ: (1) a geometric mean of 8 enterococci/100 ml or an instantaneous level of 54 enterococci/100 ml; (2) a geometric mean of 126 E. coli/100 ml or an instantaneous level of 406 E. coli/100 ml; or (3) 50 fecal coliform/100 ml by any measure or calculation. Graywater discharges shall not exceed at the EOP a geometric mean of 20 fecal coliform/100 ml for any 30-day period, with not more than 10% of the samples exceeding 40 fecal coliform/100 ml.
Settleable Materials	The discharge shall not release settleable materials other than of local and natural origin.
Suspended Solids	The discharge shall not exceed 25-mg/L daily average or 45 mg/L daily maximum concentrations of TSS.
Taste	The discharge shall not impart unpalatable flavor to food fish, shellfish, and wildlife.
Temperature	The discharge shall not cause the EOMZ temperature to increase >0.3°C.
Turbidity/Colloidal Matter	Turbidity of the discharge, including that caused by colloids, shall not be (1) visually noticeable in the receiving waters; (2) deposited to such an extent that it will detrimentally affect bottom or shoreline biota; and (3) produce a substantial increase in turbidity**.**
FRESHWATER	**EEA ENDPOINT**
Alkalinity	The discharge shall not (1) lower receiving water alkalinity below 20 mg/L; or (2) further reduce alkalinity of receiving water with an alkalinity of 20mg/L or less**.**
Hardness	The discharge shall not cause receiving water hardness to exceed 100 mg/L as calcium carbonate.
Nutrients	The discharge shall not cause the receiving water phosphorus concentration to exceed 50 μg/L.
Oil & Grease	The discharge shall not cause receiving water concentrations of oil and grease (measured as HEM) to exceed 0.10 mg/L.
Pathogens	The discharge shall not cause receiving water to exceed (1) a geometric mean of 20 fecal coliform/100 ml, or (2) exceed a geometric mean of 125 *E. coli* bacteria/100 ml.
pH	The pH of the discharge shall not (1) be less than 6.5 at EOP, (2) be greater than 9.0 at EOP, and (3) cause a receiving water change of greater than 0.5 units in pH at EOMZ.
Specific Conductance	The discharge shall not raise EOMZ conductivity of receiving water above 1000 microhms/cm.
Total Dissolved Solids	The discharge shall not cause receiving water concentration of total dissolved solids to exceed 400 mg/L.

Appendix B.

Summary Table of Narrative Water Quality Criteria Categories Determinations

Cells shaded gray identified discharge expected to fail narrative WQC; non-shaded cells identified DISCHARGES WITH non-exceeding narrative WQC. N/A indicates that the process does not apply (e.g., aircraft launch and recovery equipment is never used in freshwater).

	Aircraft Launch and Recovery Equipment		Buoy Maintenance		Cleaning Activities General Housekeeping		Deck Machinery & Weapons Lubrication		Exterior Topside Surfaces Preservation		Vessels, Aircraft, and Vehicles Refueling and Lubrication	
Saltwater Criteria Categories	**Base**	**TMP**	**Base**	**TMP**	**Base**	**TMP**	**Base**	**TMP**	**Base**	**TMP**	**Base**	**TMP**
BOD/DO												
Color												
Floating Materials												
Nutrients												
Odor												
Oil & Grease												
Pathogens												
Settleable Materials												
Suspended Solids												
Taste												
Temperature												
Turbidity/Colloidal Matter												
Freshwater Criteria Categories	**Base**	**TMP**	**Base**	**TMP**	**Base**	**TMP**	**Base**	**TMP**	**Base**	**TMP**	**Base**	**TMP**
Alkalinity	N/A	N/A										
Hardness	N/A	N/A										
Nutrients	N/A	N/A										
Oil & Grease	N/A	N/A										
Pathogens	N/A	N/A										
pH	N/A	N/A										
Specific Conductance	N/A	N/A										
Total Dissolved Solids	N/A	N/A										